

R4630

4263

R4-630

FINAL REPORT

BIOLOGICAL RECONNAISSANCE OF BOULDER ISLAND SHOAL IN
WESTERN CAMDEN BAY, BEAUFORT SEA, ALASKA

by

K. H. **Dunton**

S. V. **Schonberg**

and

Dr. Donald M. **Schell**, Principal Investigator

Institute of Water Resources/Engineering Experiment Station
University of Alaska
Fairbanks, Alaska 99701

FINAL REPORT

BI OLOGI CAL RECONNAI SSANCE OF BOULDER I SLAND SHOAL I N
WESTERN CAMDEN BAY, BEAUFORT SEA, ALASKA

by

K. H. **Dunton**

S. V. **Schonberg**

and

Dr. Donal d M. **Schell**, Pri nci pal I nvesti gator

I nsti tute of Water Resources/Engi neeri ng Experi ment Stati on
Uni versi ty of Al aska
Fai rbanks, Al aska 99701

TABLE OF CONTENTS

	<u>Page</u>
ACKNOWLEDGMENTS	2
SUMMARY OF OBJECTIVES, CONCLUSIONS, AND IMPLICATIONS WITH RESPECT TO OIL AND GAS DEVELOPMENT	3
INTRODUCTION	4
General Nature and Scope of Study	4
Specific Objectives	4
Relevance to Problems of Petroleum Development	4
CURRENT STATE OF KNOWLEDGE	7
Kelp as a Carbon Source	7
Cobbles and Boulders in Western Camden Bay	7
STUDY AREA: BEAUFORT SEA (100 PERCENT)	8
SOURCES, METHODS, AND RATIONALE OF DATA COLLECTION	8
Geophysical Survey	8
Biological Sampling and Seabed Observations	9
RESULTS AND DISCUSSION	9
Occurrence and Location of Macroalgae	9
Surficial Bottom Features	11
Fauna and Flora Collected	11
NEEDS FOR FURTHER STUDY	18
LITERATURE CITED	18

ACKNOWLEDGMENTS

We thank Jim Hanes for his expert navigation and field assistance, particularly under adverse sea and ice conditions. We are also very grateful to Joan Forshaug for her donation of field assistance, particularly during the unforeseen 24-hour absence of Jim Hanes for medical reasons. We also thank Alan Paulson for editing, Louise Flood for typing and Steve Zimmerman, who was directly responsible for the project described in this report.

SUMMARY OF OBJECTIVES, CONCLUSIONS AND IMPLICATIONS
WITH RESPECT TO OIL AND GAS DEVELOPMENT

This report presents the results of a two-day geophysical and biological survey in western Camden Bay, near Boulder Island Shoal, in the Alaskan Beaufort Sea. The primary objective of this survey was to determine if a kelp bed existed in the lee (south and west) of Boulder Island Shoal. Earlier, it was hypothesized (Dunton et al., 1983) that this shoal was the source of much of the drift kelp seen on beaches in the area.

Benthic trawls and fathometer records indicate that boulders and cobbles are rare in the survey area. However, many kelp plants were collected in trawls at certain locations south and west of Boulder Island Shoal. These plants were usually attached to pea size gravel and small pebbles. Occasionally, we dredged up plants attached to small angular cobbles up to 6 cm in diameter.

The small kelp beds located near Boulder Island Shoal are not comparable to the boulder patches in Stefansson Sound. The kelp in Camden Bay live in a relatively marginal environment in respect to both rock cover and protection from ice scour by deep-draft ice. The major limiting resource is rock substrata, which kelp require for attachment to the seafloor. The rich invertebrate assemblage, common to the Boulder Patch in Stefansson Sound, is also lacking.

Despite the limited size and diversity of this community, kelp and associated fauna do occur. As such, site-specific diving surveys should be conducted prior to the construction of offshore facilities to minimize the impact on these rare communities.

INTRODUCTION

General Nature and Scope of Study

The primary goal of the **benthic** survey in western Camden Bay was to provide information on the occurrence of kelp in the vicinity of Boulder Island Shoal (Figure 1). The survey area extended to the south and west of the shoal as shown in Figure 2. Severe ice conditions permitted very little work north of the shoal, even with a small boat. A Ross SL-500 recording **fathometer** was used in conjunction with **benthic** trawls to map the character of the seabed.

Specific Objectives

1. Determine the presence and location of kelp beds in the vicinity of Boulder Island Shoal in western Camden Bay.
2. As time permits, determine the **areal** extent of the kelp beds and their floral and **faunal** composition.

Relevance to Problems of Petroleum Development

In Stefansson Sound, the presence of an abundant and diverse flora and fauna associated with cobbles and boulders resulted in special protection for the Boulder Patch from industrial activity related to petroleum exploration. The kelp in the Boulder Patch contributes the largest fraction of carbon in this area, and this carbon source is utilized by many invertebrate consumers. The presence of a similar kelp community in western Camden Bay may thus require similar attention, depending on its size and composition.



Figure 1. Boulder Island Shoal (looking east from its western tip) in western Camden Bay. The shoal made its first appearance in many years in 1983 (Reimnitz, personal communication).

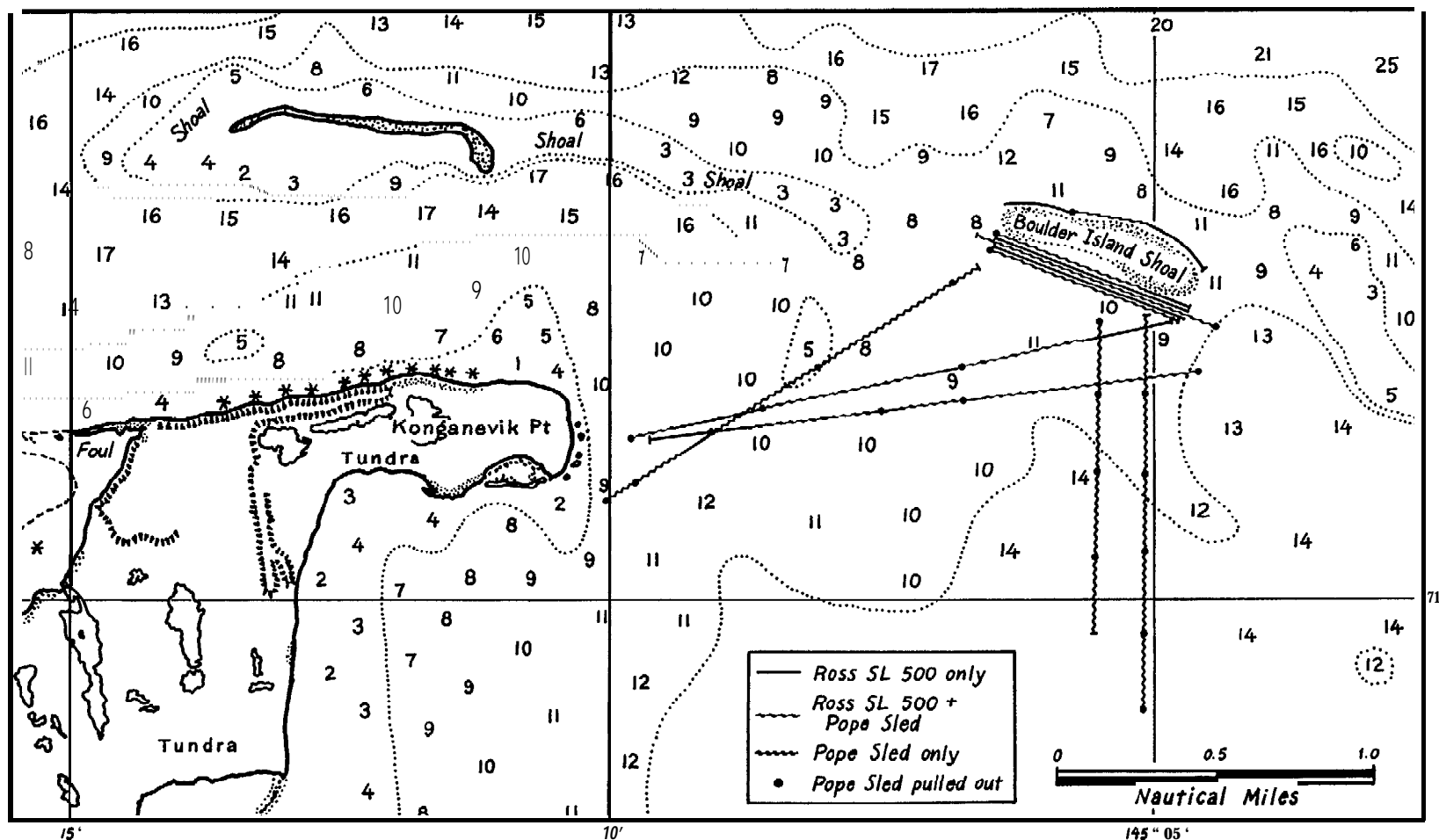


Figure 2.

The study area extended from Konganevik Point to an imaginary line running south from the eastern tip of Boulder Island Shoal in water depths ranging between 3 and 5 meters (depths are listed in feet). The location of the sled and geophysical transects are shown. Solid circles along each transect line indicate places where the contents of the sled were removed and the transect restarted.

CURRENT STATE OF KNOWLEDGE

Kelp as a Carbon Source

Although the input of terrestrial peat carbon to the nearshore Alaskan Beaufort Sea is of the same magnitude as that derived from marine sources, marine primary production supplies nearly all of the carbon used in arctic marine foodwebs (Schell, 1983). Most of this carbon is supplied by **phytoplankton**, but benthic **microalgae** and ice algae also contribute carbon on a less consistent temporal and spatial scale. The discovery of the Boulder Patch and its large population of flora and fauna by E. Reimnitz in 1971 also led to the discovery of another marine carbon source of unknown magnitude -- kelp. Subsequent long-term in situ productivity studies indicated that the carbon contribution made by kelp in the Boulder Patch doubled the amount of carbon available to consumers in that region (Dunton et al., 1982). It also appears that kelp is an alternate food source for many animals that primarily rely on **phytoplankton**. Thus, the kelp communities found in association with "boulder patches" may not only be unusual but also supply a source of carbon that is utilized by organisms that are eaten by birds, fishes, and marine mammals (Dunton and Schell, 1982).

Cobbles and Boulders in Western Camden Bay

The presence of cobbles and boulders in western Camden Bay was first reported by Barnes and Ross (1980). Subsequent investigation of the seabed using underwater television showed that the rocks supported a diverse **benthic** community (Barnes, 1981). This **benthic** community appeared similar to the Boulder Patch (Reimnitz and Ross, 1979; Dunton et al., 1982) in the types of organisms present. In August 1981, some of the nearshore boulder ridges described by Barnes (1981) were examined by divers (Dunton and Schonberg, 1981). Their short examination revealed patchy occurrences of rocks where Barnes (1981) had indicated, but the benthic fauna and flora were not comparable in density or diversity to that of the Boulder Patch. However, only a few rock patches were examined, and these were in relatively shallow water (less than 3.5 m depth). Biological assemblages are more likely to possess a

greater luxuriance in deeper water which affords greater protection from the thick winter ice.

From monographs, Barnes and Ross (1980) identified several locations where they postulated the existence of boulders and cobbles on the seabed in deeper water. No boulders or cobbles were found, however, when the area was thoroughly investigated using divers and a variety of benthic sampling equipment (Dunton et al., 1983). Since Barnes and Ross did not make any direct seabed observations, it appears that they may have misinterpreted certain ambiguities in their monographs, confusing boulders with other topographical features on the seabed (Dunton et al., 1983).

STUDY AREA: BEAUFORT SEA (100 PERCENT)

The study area for this project is western Camden Bay, south of Boulder Island Shoal, between longitude 145°05' and 145°10', in water depths ranging from 3 to 5 m (Fig. 2). Calibration of geophysical instruments was conducted at OCSEAP DS-11 in Stefansson Sound.

SOURCES, METHODS, AND RATIONALE OF DATA COLLECTION

Geophysical survey data and samples were collected from the *R/v Proteus*, a 25-foot Boston Whaler leased to OCSEAP by Arctic Marine Research Associates. The vessel carried a crew of three, was fully canvassed and powered by twin 140 HP outboard engines. Navigation equipment included a Furuno 16-mile radar, flasher fathometer, compass, and RDF (radio direction finder). Mast, boom and outriggers provided a means to tow and retrieve trawl equipment from the stern, port, or starboard sides.

Geophysical Survey

Geophysical coverage was obtained across the study area along the transects shown in Figure 2. The acoustical system was a Ross Model

SL-500 recording fathometer. This instrument has been used successfully in previous studies in Stefansson Sound to locate boulder patches. It uses a narrow beam 200 kHz transducer and produces a paper copy fathogram. Boulders and cobbles on the seafloor are indicated on traces by elongate return signals and by slight surface roughness. All survey transects were established using a compass and radar fixes from natural and artificial land targets. Radar targets were also placed on Boulder Island Shoal. Navigation fixes are generally accurate within ± 200 m.

Biological Sampling and Seabed Observations

Biological samples were collected using our Pope sled, a small specially designed sled for sampling rocky bottoms (Dunton et al., 1983). Locations of sled transects are shown in Figure 2. Due to unforeseen medical problems suffered by one of the crew, no diving was accomplished, although underwater photographs of the seabed were taken on the south side of Boulder Island Shoal by wading.

RESULTS AND DISCUSSION

Occurrence and Location of Macroalgae

Figure 3 shows the relative density of kelp along various segments of our transect lines based on collections from the Pope sled. Although plants were found scattered throughout the survey area, the greatest number of plants were collected at two locations: the first, directly south of Boulder Island Shoal in water depths of 3 to 4 meters; and the second, southwest of the shoal at depths of 3 m.

The density of plants in this area appears relatively low compared to the Boulder Patch. Nonetheless, the abundance of kelp in such a large area would seem now to account for the drift on beaches directly south of the shoal on Soplú Spit and on barrier islands to the west (Dunton et al., 1983).

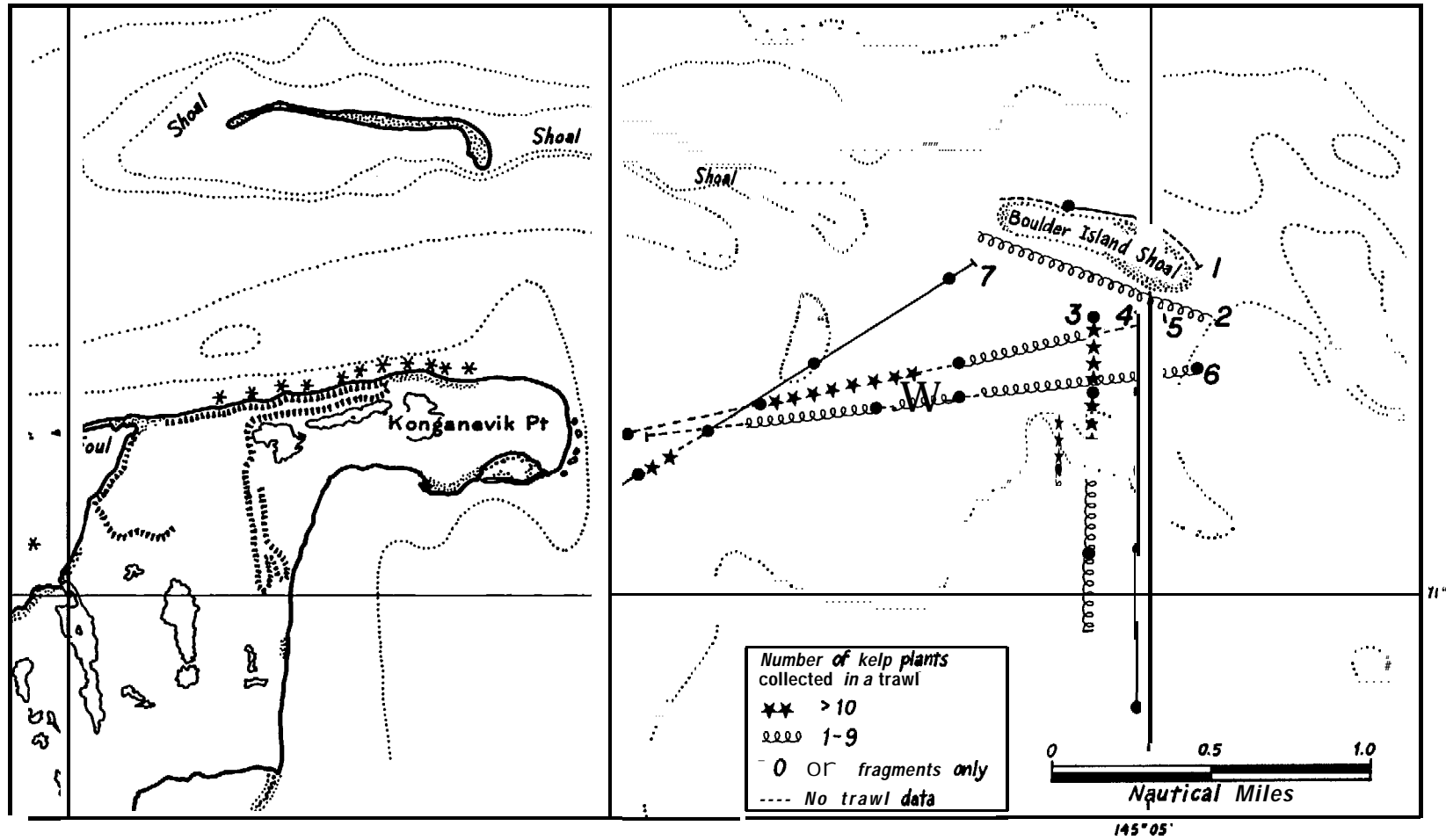


Figure 3. The numbers of plants collected along various segments of each transect in the survey area.

Surficial Bottom Features

Bottom traces from the Ross SL-500 revealed little topographical relief (Figure 4). This was also confirmed from the trawls -- rocks larger than pebble size were rare. Occasionally, we collected small angular cobbles up to 6 cm in diameter with attached kelp. The sediments in the area varied from stiff clays to **soft** mud. Ice gouges were evident in the area.

Direct observation of the seabed was made in shallow water (<2 m) from the southwestern shore of the shoal. We found the bottom to consist of small cobbles, gravel, and sand (Figure 5). Our **trawl** data indicated, however, that the frequency of the pebbles and cobbles dropped rapidly as we moved from the shore into water depths of 3 to 4 m.

Fauna and Flora Collected

The fauna and flora collected along various segments of each of the major transects are listed in Table 1. Three species of kelp (Laminaria solidungula, L. saccharin, and Alaria esculenta) were collected in the trawls. L. saccharin (Figure 6) was collected most frequently. This is likely due to substrate limitations, since this plant possesses **rhizoidal** holdfasts which allow it to colonize gravel, small pebbles and even **detrital** material (Figure 7). On the other hand, L. solidungula has a discoidal holdfast, which limits its occurrence to larger pebbles or preferably cobble-sized rocks, which are largely absent in the survey area. Except **for** drift material, all plants collected appeared healthy and reproductively mature.

Several species of red algae were collected among the kelp. These included Rhodomela confervoides, Odonthalia dentata, Phycodrys rubens, and Phyllophora truncata. We found only a few animal species associated with the kelp bed community. These included the sponge Haliclona gracilis (Figure 7), and a variety of hydroids and bryozoans (Table 1).

TABLE 1. Summary of material collected in trawls made in western Camden Bay. See Figure 2 for location of transects. Segments of each transect (delineated by solid circles in Figure 2) are ordered starting from Boulder Island Shoal.

Transect Number	Segment of Transect	Material Collected
1		No attached biota . Pebbles and small cobbles (up to 5 cm diameter).
2		<u>Laminaria saccharin</u> attached to pebbles; <u>Odonthalia dentata</u> (red alga); large fragments of <u>L. solidungula</u> and <u>L. saccharin</u> .
3	1st Quarter	Many <u>L. saccharin</u> and <u>L. solidungula</u> plants. Mud.
	2nd Quarter	Many <u>L. saccharin</u> (30-100 cm long) and <u>L. solidungula</u> (30-40 cm long) plants. <u>Rhodomela confervoides</u> and bryozoans attached to kelp and small cobbles.
	3rd Quarter	Several <u>L. saccharin</u> , <u>L. solidungula</u> and <u>Phyllophora truncata</u> (red alga) plants. Hydroids collected on small pebbles.
	4th Quarter	<u>Alaria esculenta</u> , <u>L. saccharin</u> , red algae (<u>Rhodomela confervoides</u> and <u>Pyrrhophora truncata</u>), hydroids (<u>Thuiaria</u> sp.), sponges (<u>Haliclona gracilis</u>), and bryozoans (<u>Flustrella</u> sp.) attached to small cobbles approximately 6 cm in diameter.
	1st Fifth	One piece drift kelp. Gravel.
	2nd Fifth	Mud and silty sand. No attached biota .
	3rd Fifth	No attached biota .
	4th Fifth	Many <u>L. saccharin</u> (20-30 cm long) and <u>L. solidungula</u> plants attached to small flat cobbles (5-6 cm diameter). Also <u>Rhodomela confervoides</u> and hydroids attached to small cobbles.
	Last Fifth	Flocculent mud.
5	1st Third	Several <u>L. saccharin</u> and <u>Phyllophora truncata</u> plants.

TABLE 1. (Continued)

Transect Number	of Transect	Material Collected
5	2nd Third	Many (greater than 30) <u>L. saccharin</u> and <u>L. solidungula</u> plants attached to pebbles. Also <u>Phyllophora truncata</u> and <u>Odonthalia dentata</u> .
	Last Third	No data.
	1st Third	<u>L. saccharin</u> (fragments and whole plants) attached to pebbles. Hydroids growing on stipes of plants.
	2nd Third	<u>L. saccharin</u> (fragments and whole plants) attached to pebbles. Hydroids growing on stipes of plants.
	Last Third	Several <u>L. saccharin</u> (10-50 cm long) plants. <u>Phyllophora truncata</u> and hydroids attached to holdfast and stipe.
	1st Fifth	Fragments of kelp and red algae.
	2nd Fifth	Fragments of kelp and red algae.
	3rd Fifth	Fragments of kelp and red algae. Sand.
	4th Fifth	Trawl filled with <u>L. saccharin</u> , <u>L. solidungula</u> , <u>A. esculenta</u> , and red algae (<u>Phyllophora</u> and <u>Rhodomeia</u>). Plants attached to small cobbles.
	Last Fifth	No biota.

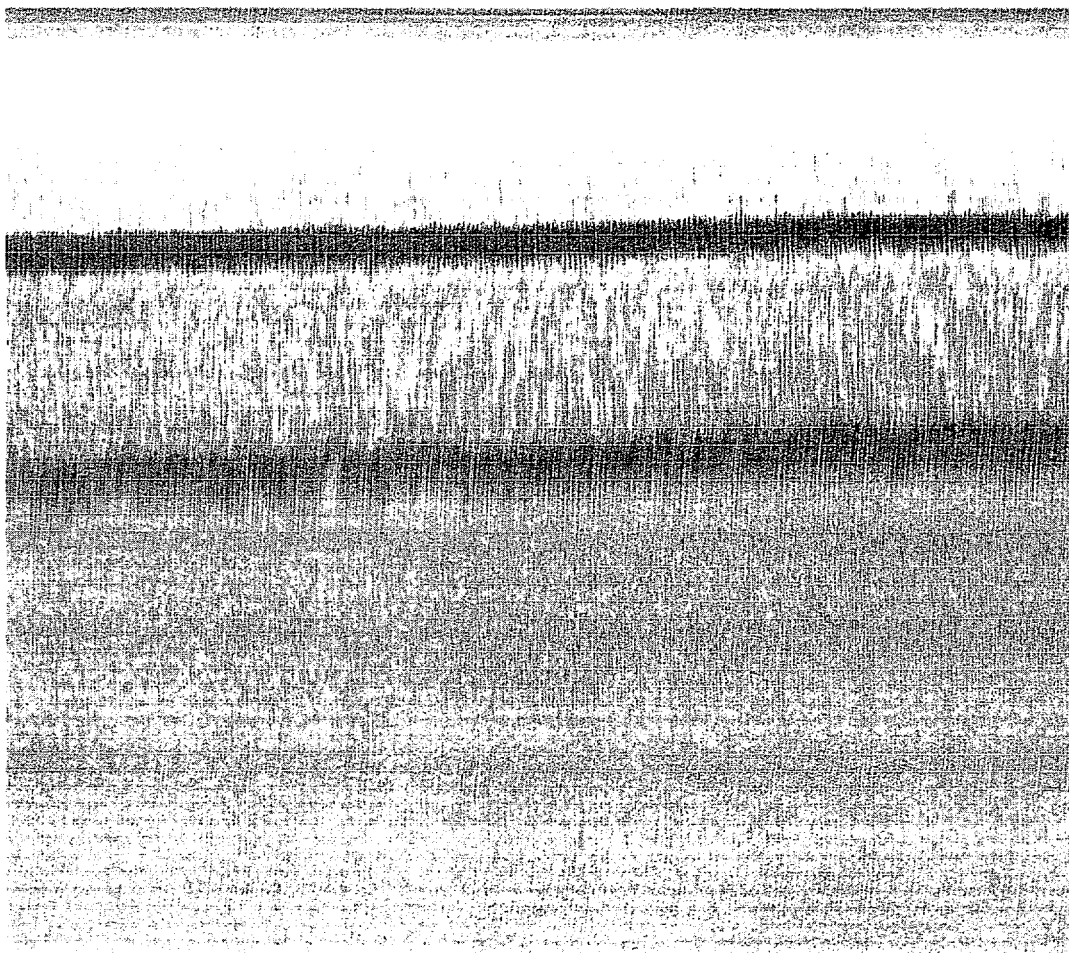


Figure 4. The Ross SL-500 depth recorder trace of the seafloor along the middle segment (asterisked portion) of transect 5. The trace shows a flat seabed surface, despite the presence of kelp along this portion of the transect (see Figure 3).

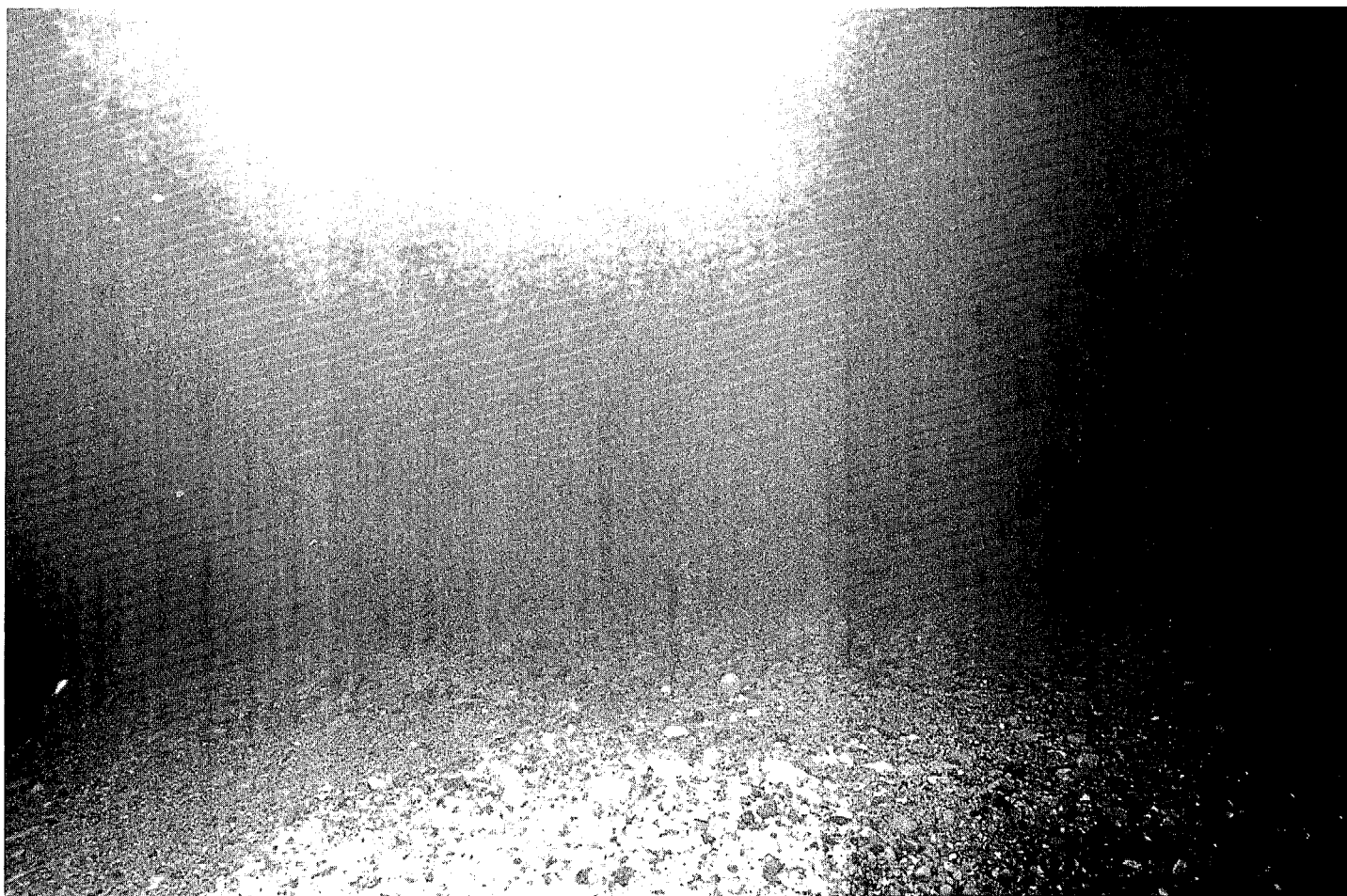


Figure 5. The seafloor at a depth of 2 m along the southwestern tip of Boulder Island Shoal consists of small cobbles, pebbles and sand.



Figure 6. Two species of kelp, *Laminaria saccharina* and *Alaria esculenta* (with midrib), were collected in the trawls. The largest plants in this photograph are nearly a meter long.

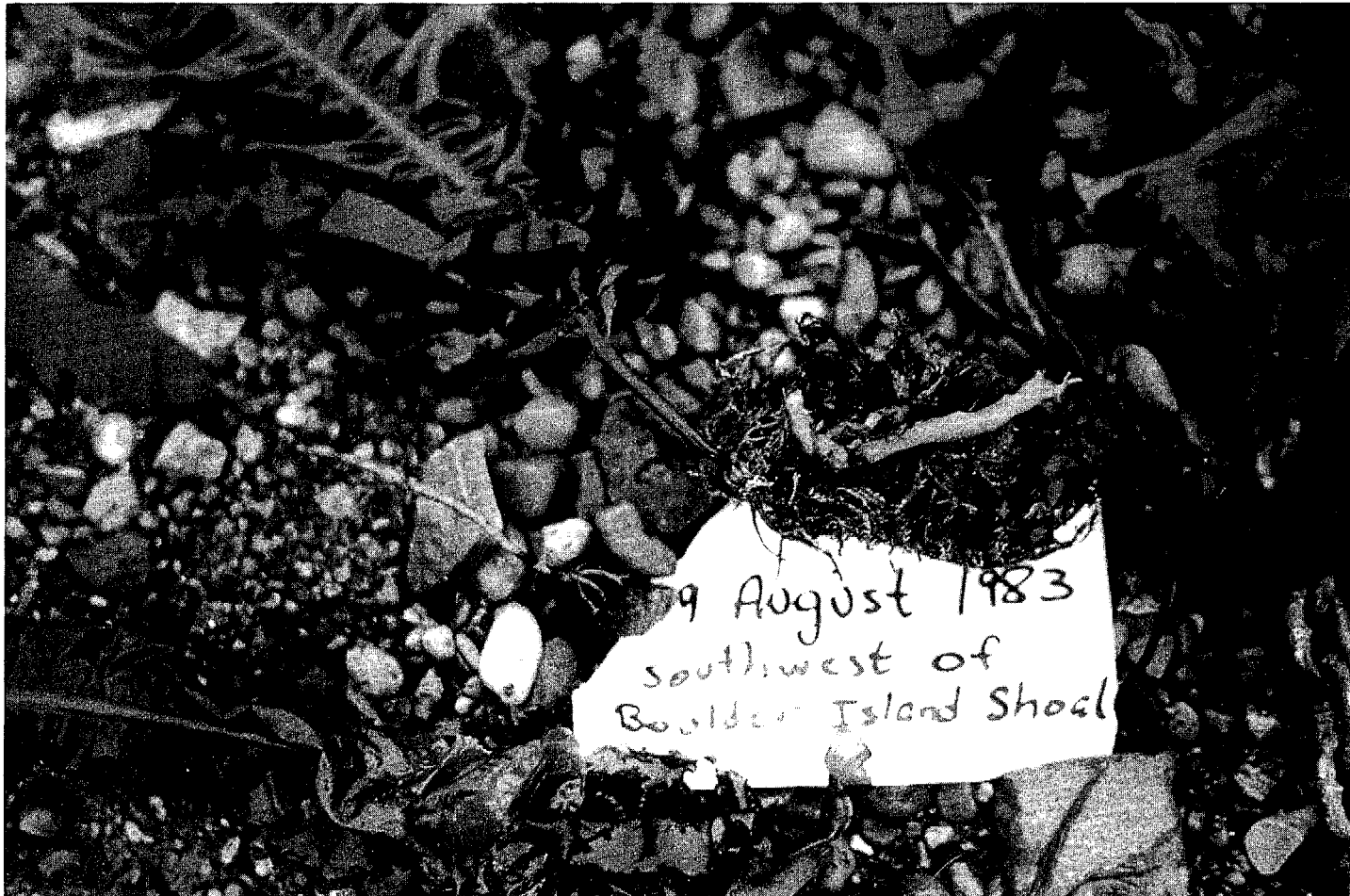


Figure 7. Only a few species of animals were found associated with the kelp. The sponge Haliclona was one species found attached to the rhizoidal holdfasts of L. saccharin and A. esculenta.

NEEDS FOR FURTHER STUDY

The source of large amounts of drift kelp on beaches east of the survey area appears to be from areas south and west of Boulder Island Shoal . Unless there is a need to investigate the composition and size of this community more thoroughly, there are no needs for further field work involving kelp beds in this area.

LITERATURE CITED

- Barnes, P.W. 1981. Camden Bay "Boulder Patch." In: Barnes, P., and Reimnitz, E. Geological Processes and Hazards of the Beaufort Sea Shelf and Coastal Regions. Annual Report, 1981. Nat. Oceanic Atmos. Admin., Boulder, CO. Attachment B. 4 p.
- Barnes, P.W. 1982. Marine ice-pushed boulder ridge, Beaufort Sea, Alaska. Arctic. 35(2):312-316.
- Barnes, P.W., and Ross, C.R. 1980. Ice-pushed boulder pile - Camden Bay, Alaska. In: National Oceanic and Atmospheric Adm., Environmental Assessment of the Alaskan Continental Shelf; Investigators Quarterly Reports, January 1980. 11 p.
- Dunton, K.H., Reimnitz, E., and Schonberg, S. 1982. An arctic kelp community in the Alaskan Beaufort Sea. Arctic. 35(4):465-484.
- Dunton, K.H., and Schell, D.M. 1982. The use of $^{13}\text{C}:^{12}\text{C}$ ratios to determine the role of macrophyte carbon in an arctic kelp community. Eos. 63:54 (abstract).
- Dunton, K.H., and Schonberg, S.V. 1981. The Canning River to Demarcation Bay: A preliminary survey of macrophyte communities. Cruise and summary report. NOAA Environmental Research Labs, Boulder, CO. 47 p.

Dunton, K.H., Schonberg, S.V., and **Schell, D.M.** 1983. Geophysical and biological reconnaissance of rock habitats in western Camden Bay, Beaufort Sea, Alaska. Institute of Water Resources, University of Alaska, Fairbanks. Report IWR-104. 30 p.

Reimnitz, E., and Ross, **C.R.** 1979. Lag deposits of boulders in **Stefansson** Sound; Beaufort Sea, Alaska. U.S. Geological Survey Open File Report 79-1205. 16 p.

Schell, D.M. 1983. Carbon-13 and carbon-14 abundances in Alaskan aquatic organisms: delayed production from peat in arctic food webs. Science. **219:1068-1071.**

Schell, D.M., Ziemann, P.J., Parrish, D.M., Dunton, K.H., and Brown, E.J. 1982. Foodweb and nutrient dynamics in nearshore Alaskan Beaufort Sea waters. In: Environmental Assessment of the Alaskan Continental Shelf: Final Report. BLM/NOAA/OCSEAP, Boulder, CO. 185 p.